Understanding the Economic Breeding Index (EBI).

What is EBI?

EBI is a single figure profit index aimed at helping farmers identify the most profitable bulls and cows for breeding dairy herd replacements. It comprises of information on seven sub-indexes related to profitable milk production. These are; (**1**) Milk Production, (**2**) Fertility, (**3**) Calving Performance, (**4**) Beef Carcass (**5**) Cow Maintenance (**6**) Cow Management and (**7**) Health. A summary of the sub-indexes, including traits and relative weightings for traits in the EBI is displayed in **Chart 1**, e.g. Fertility has a 33% weighting in the EBI. Economic values in the index are based on data collected from Irish Dairy Farms and the Dairy Industry. These values were last updated in December 2017.

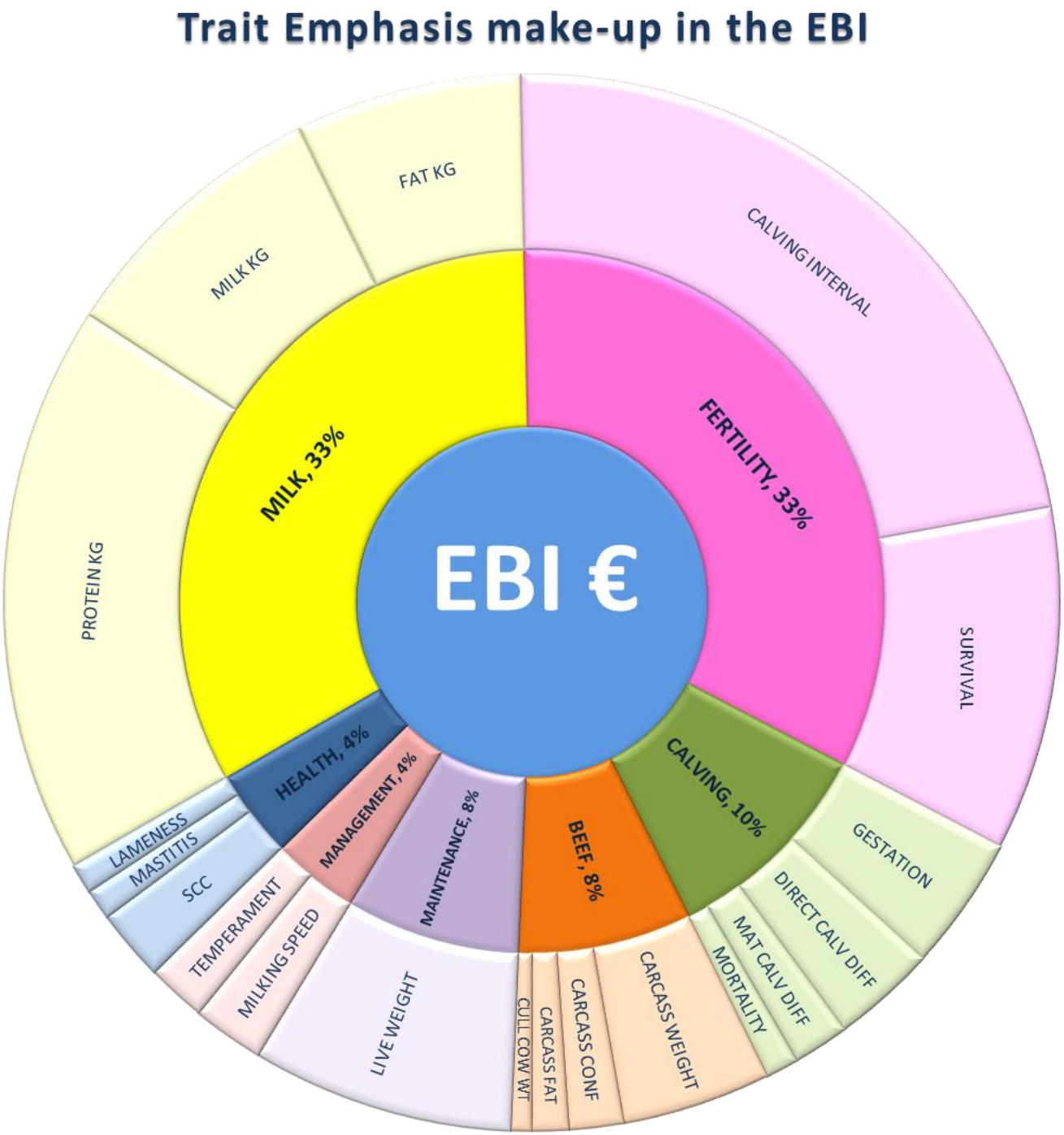


Chart 1. *Percentage emphasis of the various traits in the EBI formula.*

Improvements to EBI for the January 2020 evaluation run

There are 3 main changes to the EBI in the January 2020 evaluation run:

1) Genomics for other dairy breeds and the inclusion of females in the genomic reference population.
2) New calving traits specific to the dairy herd
3) Switch from cull cow weight to cow liveweight PTA in the Maintenance sub-index

1) **Genomics for other dairy breeds and females in the genomic reference population.**

What is genomics?

Genomics uses DNA to help predict how an animal will perform in the future. The DNA profile of an animal is analysed and is benchmarked against the DNA profiles of proven animals in the reference population. Performance data, ancestry data and genomic data are then combined generating a more accurate prediction of the animal's genetic make-up.

What is a genomic reference population?

To generate genomic evaluations, a reference population needs to be developed and continually updated. This is a population of genotyped animals with accurate performance information on key traits like milk yield and fertility. The associations between the DNA and performance measures are then developed from this population. Previously, there were in the region of 10,000 informative Holstein Friesian sires in the Irish training population. Roughly half of these were Irish born with the other half proven in other countries. Many countries have now begun the inclusion of informative females into their reference populations. All these countries have been able to demonstrate increase accuracy of prediction with the females included. In Ireland we now have in the region of 42,000 informative females which are now being included in the reference population for the January 2020 evaluations. Among these new additions are females (3,600) and males (300) from other dairy breeds. The impact of the increased reference population has been validated and shown to increase the accuracy/stability of prediction. Across the Milk, Fertility and Health traits the increase in accuracy of prediction is +26% compared to an EBI without genomics and +8% compared to the previous genomic process.

2) **New calving traits specific to the dairy herd**

A new calving evaluation has been developed to facilitate more targeted breeding decisions. The old calving difficulty has been replaced by 2 new traits for the dairy herd: Dairy Heifer Calving difficulty and Dairy Cow Calving difficulty. Both are expressed on a % difficulty scale similar to the old system. There is a reliability measure allocated to each trait which will allow more visibility on whether a bull is proven on heifers or cows. An additional measure is now also available relating to the Risk of Difficulty when using a bull on Heifers. This Risk measure uses the heifer PTA on the bull but now also the reliability and the variation in the breed when making a recommendation on the sire. There are 3 categories published: Low, Medium and High Risk. Bulls not genotyped are automatically defaulted to High Risk as it cannot be guaranteed that the sire of the bull is correct without parentage verification through genotyping.

3) **Switch from cull cow weight to cow liveweight PTA in the Maintenance sub-index**

Liveweight is viewed worldwide as the best predictor of the maintenance requirements of a dairy cow. Up to now the EBI has used cull cow weight as a proxy for liveweight due to the lack of available liveweight records. However, there are now sufficient liveweight records available to produce a PTA for liveweight. At a breed level the average Maintenance Sub-index change is +€1 for Holstein (now €7) and Friesian (now €16) and -€15 for Jersey (now €47). The changes reflect the impact of kill-out % differences between the breeds which impacts the difference between cull cow carcass weight and liveweight.

Impact of changes on Active AI sires

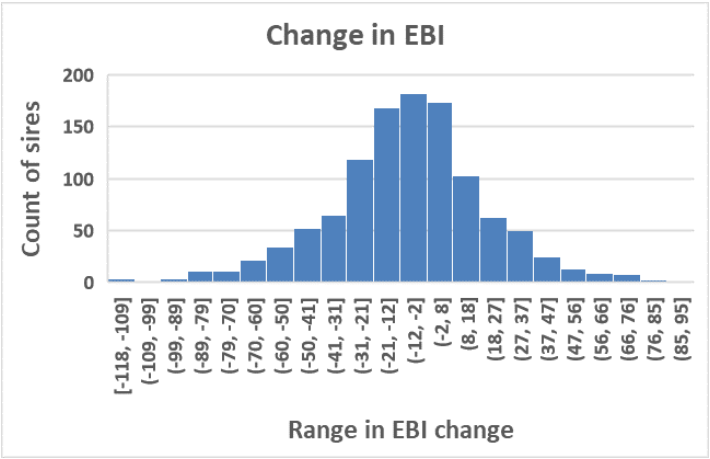
The new changes will bring about change in sire rankings on the Active bull list. Table 1 shows the average change for 1118 Active sires for the EBI and the Milk, Fertility and Maintenance index and associated reliabilities. Figure 1 shows the distribution of the change (for example the central category with the highest sire count (180 sires) are sires that moved between -€12 and -€2 euro). 50% of sires moved between -€23 and +€8. 80% of sires moved between -€46 and €26 and 98% of sires moved between -€86 and +€65.

For the first time genomic evaluations are now also available on other dairy breeds for all the traits in the EBI for both males and females. In total 116 Active AI sires and 5,495 cows of other breeds are now receiving genomic evaluations with an increase in EBI reliability for the sires of +15% (€60 to €75) and for the cows of +20% (45% to 65%).

Table 1. Active sire Index avg Nov 2019 v Jan 2020

Index	*Nov-19*	*Jan-20*	*Difference*
EBI	€156	€147	-€9
EBI reliability	73%	79%	6%
Milk SI	€57	€55	-€2
Milk SI reliability	83%	91%	8%
Fertility SI	€57	€57	€0
Fertility SI reliability	66%	73%	7%
Maintenance SI	€10	€11	€1
Maintenance SI reliability	64%	64.60%	€0

Figure1. Distribution of change in EBI for Active sires



Genetic Evaluations

Knowing the genetic merit of your herd is a **key** component to successfully improving traits of importance on your farm. The observed performance of an individual cow depends on two things:

a) **The genetic merit of the cows**
b) **The environment in which she is performing**

Genetic evaluations attempt to disentangle the effects of genes and the environment, to select animals that have high genetic merit, and not those that perform well simply because they are well managed and fed. For example, if Cow **X** has a much higher genetic merit for milk yield than Cow **Y**, Cow **Y** will need much more feed to milk the same as Cow **X**. Alternatively, if Cow **X** and **Y** are fed the same, Cow **X** will outperform Cow **Y** for milk yield. Genetic evaluations allow us to directly compare animals that are performing in many environments, by removing the part of the observed performance that is due to the environment and management of the cows.

We cannot directly alter the genetic merit of an individual cow, however improvements can be made for specific traits in the offspring of the cow provided she is bred to a sire that is better than she is for those traits. Therefore, it is important to know both the genetic merit of the cow and the sire, to make genetic improvements in traits of economic importance.

How do I interpret the Predicted figures for Milk kg, Fat kg, etc. on my EBI Report?
We call these Predicted Transmitting Ability figures (PTAs). An animal's PTA indicates the amount of a particular trait an animal is expected to pass on to its progeny, relative to the base cow population. The PTA is equal to half of its own Breeding Value since a cow only passes on half her genes to her offspring. All values on the EBI report are expressed as PTA's. Information on bulls (in catalogues, bull search, etc.) is also presented in terms of PTA.

What is the Base Cow?
The base for production and fertility is 2005 born cows, calved and milk recorded in 2007, with at least 2 years out of 5 milk recorded (**Table 1**). The production figure uses a weighting of each lactation used in the evaluations; 1st lactation 0.41, second lactation 0.33 and 3+ lactation 0.26. These weightings are based on the number of records in the evaluation.

	Milk Kg	Fat Kg	Prot Kg	Fat %	Prot %	Weighting	Calv Int	Sur%
Parity 1	5538	216.3	188.0	3.91	3.39	0.41		
Parity 2	6246	243.7	216.1	3.90	3.46	0.33		
Partiy 3+	6587	258.0	227.1	3.92	3.45	0.26		
Base Cow Performance	**6044**	**236.2**	**207.5**	**3.91**	**3.43**	**1.00**	**398.8**	**85.3**

Table 1. ***Base Population Performance – 2005 born cows, calved and milk recorded in 2007 (Updated Dec 2017)***

The daughters of a bull with a PTA of 150kg for milk yield would be expected to produce, on average, 100kg more milk per lactation than the daughters of a bull with a PTA of 50kg if their dams have equal genetic merit. The actual difference will not be exact for comparing individual daughters because no two daughters get exactly the same combination of genes and are not exposed to exactly the same environment. Thus, daughters of the same sire may have varying performance.

Example:
Cow 972 (**Fig 1.** below) has a Milk kg PTA of **+167kg** which means that she would be expected to produce 334 kg more milk than the base cow (167kg x 2 = 334kg). If she is mated to a bull with a Milk kg of **+233kg** the resultant offspring will have a potential for milk (i.e. Breeding Value) of **+400kg**.

FB Cow ID Name Breed	Sire ID Dam FB MG Sire ID	Sire EBI Dam EBI MGS EBI	C. Date Age Lact.	Milk Kg Fat Kg % Prot Kg %	Milk	Fertility	Calving Health	Beef Mainten	EBI € Herd Rank
972 IE151013760972	RUU	138	25/01/2009	167	€ 25	€ 32	€ 26	€ 5	€ 84
P TRUDY 8	383	39	3y 2m	9.0 0.05			€ 3	€ -9	
HO 93.8%	ASI	34	1	5.0 -0.01					64

Fig 1. ***Example of an animal's PTA in the EBI Report***

Does this mean the offspring, assuming a heifer, will milk 400Kg more than the "base cow" (i.e. 6044kg + 400kg = 6444kg)? The answer always depends on the level of management – the heifer will be genetically capable of milking 400kg more than the base cow but how much she physically outperforms the base cow will be dependent on the management of the animal. In a higher input environment, she could perform much more than this or in a lower input environment it may be less than this.

Key Point: Although the potential of the offspring heifer is **+400kg**, she will only pass on half of this to her own offspring, therefore her PTA for milk kg is **+200kg** (½ her Breeding Value) and this is what is displayed on the EBI report.

In simple terms, to improve the potential of a cow's offspring to milk more, you need to use bulls that have a higher PTA for milk kg than the cow itself. The same applies to all other traits, be it milk solids yield, fat and protein % etc.

When selecting a team of bulls, you should pick bulls that are higher than the herd PTA for the traits you want to improve. To improve individual cow weaknesses use the cow PTA to help you determine the best bull to use on her.